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ABSTRACT

Computer Assisted Remedial Education (CARE) I was developed to provide a college level computer-assisted instruction (CAI) course for preschool and elementary school teachers dealing with the identification and diagnosis of handicapping conditions in children. This fourth volume of the final report of CARE I is a planning manual giving a detailed description of all the programing techniques used. A first section presents a modified PERT chart with a list of activities and events required to produce one hour of tutorial CAI. Section Two is an alphabetically ordered list of certain techniques or conventions that were used in the CARE I project. EM 011 037 through EM 011 043, EM 011 046, EM 011 047, and EM 011 049 through EM 011 058 are related documents. (Author/SH)

C·A·I

COMPUTER ASSISTED INSTRUCTION LABORATORY

COLLEGE OF EDUCATION · CHAMBERS BUILDING

THE PENNSYLVANIA STATE UNIVERSITY · UNIVERSITY PARK, PA.

Computer Assisted Remedial Education:

Early Identification of Handicapped Children

Course Planning Manual

David D. Palmer

Bonnie J. Shea

G. Phillip Cartwright

Report No. R–42

June 1971

Note to accompany the Penn State Documents.

In order to have the entire collection of reports generated by the Computer Assisted Instruction Lab. at Penn State University included in the ERIC archives, the ERIC Clearinghouse on Educational Media and Technology was asked by Penn State to input the material. We are therefore including some documents which may be several years old. Also, so that our bibliographic information will conform with Penn State's, we have occasionally changed the title somewhat, or added information that may not be on the title page. Two of the documents in the CARE (Computer Assisted Remedial Education) collection were transferred to ERIC/EC to abstract. They are Report Number R-36 and Report Number R-50.

— Doctor Carroll, ERIC/EM

IBM 1500 Instructional System
Course Planning Manual

David D. Palmer, Bonnie J. Shea, and
G. Phillip Cartwright

Computer Assisted Instruction Laboratory
College of Education
The Pennsylvania State University
University Park, Pa. 16802

Report No. R-42
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Ultimate responsibility for course content rests with the principal investigators, Professor G. Phillip Cartwright and Professor Harold E. Mitzel. Professor Carol A. Cartwright played a major role in the overall development of the conceptual model. She also wrote many of the instructional chapters. Other persons who authored or contributed to the authoring of instructional chapters were Asa Berlin, Karen Braddock, Judson McCune, Gerald Robine, David Sabatino, Mary Sabatino, Deborah Schreiber, Robert Sedlak, Richard Starr, and Mary Ann Villwock. Alma Fandal, Steven Hunka, Ralph Peabody, and Herbert Quay served as consultants.

There are numerous support people to whom the investigators are also indebted. The programers--Karen Braddock, Rosemary Hollick, Carolyn Kendall, David Palmer, and Bonnie Shea--interpreted authored materials and programed it in Coursewriter II language. David Palmer supervised operations and coordinated activities with technical personnel. Other course related activities were handled by graduate assistants: Judson McCune, Robert Sedlak, Richard Starr, Mary Ann Villwock, and David Yens.

Leslye Bloom prepared all images for the image projectors and illustrations for the Handbook. Karl Borman was in charge of technical support. The narrative was recorded by Croy Pitzer.

Clerical support was provided by Kris Sefchick, Barbara Lippincott, Kathy Hatton, Sara Jane Thomas, Judy Harley, and Darlene Smith.

FOREWORD

Nearly four million handicapped children in the United States--200,000 in Pennsylvania alone--are not receiving the special educational services that they require in order to become self-supporting, self-respecting citizens. In order to adequately provide for these children, almost 300,000 more specially trained persons are needed to work with handicapped children. The present methods of training educational personnel cannot provide enough trained people to meet these needs.

CARE 1 was developed to provide a complete college-level computer-assisted instruction (CAI) course dealing with the identification and diagnosis of handicapping conditions in children. The course was aimed toward preschool and primary level teachers of seemingly typical children.

This course has been designed to demonstrate the contribution that new educational technology can make in the education and training of teachers (especially inservice teachers) and in providing high quality education to teachers who might not have the opportunity to return to a college campus for refresher training. It is hoped that the course will dramatize the effect that educational technology can have in the field of special education.

Personnel in the department of Special Education and Elementary Education and the Computer Assisted Instruction Laboratory at The Pennsylvania State University have cooperated to develop the program for the IBM 1500 Instructional System located at Penn State. When completed, the course was then transferred to an IBM 1500 System in a mobile laboratory and disseminated to teachers throughout the Pennsylvania Appalachian Region.

This Final Report of CARE 1 is in five volumes. Volume 1 covers the purpose and objectives of the course, the nature of CAI, a general course description, phases of development, course materials, and evaluative methods and results. Volume II is the CARE 1 Handbook, which is not only a summary of the course but also a valuable tool for the student while he takes the course. A Syllabus describing the content and objectives of each instructional frame is Volume III. Volume IV is a planning manual, a detailed description of all the programing techniques used in CARE 1. It is not only a report but is also

designed as a programer's guide for future CAI courses. Volume V is a computer tape which contains the entire CAI course in an easily readable form. The tape also contains all the Coursewriter II coding.

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INTRODUCTION

The following Planning Manual is intended as a guide for authors and programers of future CAI courses. It grew out of the experiences gained while programing CARE 1 (Computer Assisted Remedial Education) and is written under the assumption that experiences are transferrable and valuable if they can prevent repetitions of errors and inefficiencies, especially in costly and time consuming computer program production.

While this Manual stresses the necessity for planning ahead, it recognizes that some unanticipated, in-process changes are inevitable during the developmental phase of any computer course.

This manual contains two sections. Section One is a modified PERT Chart with a list of activities and events required to produce one hour of tutorial CAI.

Section Two is an alphabetically ordered list of certain techniques or conventions that were used in the CARE 1 project. The PERT chart is based to some extent on these conventions.

Development of the CAI course CARE 1 was carried out under a grant from the Bureau of Education for the Handicapped, United States Office of Education [Project No. 48-2129, Grant No. OEG-0-9-482129-4394 (032)]. Project directors were G. Phillip Cartwright and Harold E. Mitzel.

SECTION ONE

MODIFIED PERT CHART

The following modified PERT network was developed as a result of experiences of the staff on the CARE 1 project. The chart is designed to illustrate the events[1] and activities[2] that are required to produce one hour of tutorial CAI. Author time (preparation of course content and strategies) is not included in the PERT chart.

The following averages were used to estimate the time required:

125 author program sheets;
18 audio messages;
22 images;
155 sectors; and
3700 Coursewriter II statements.

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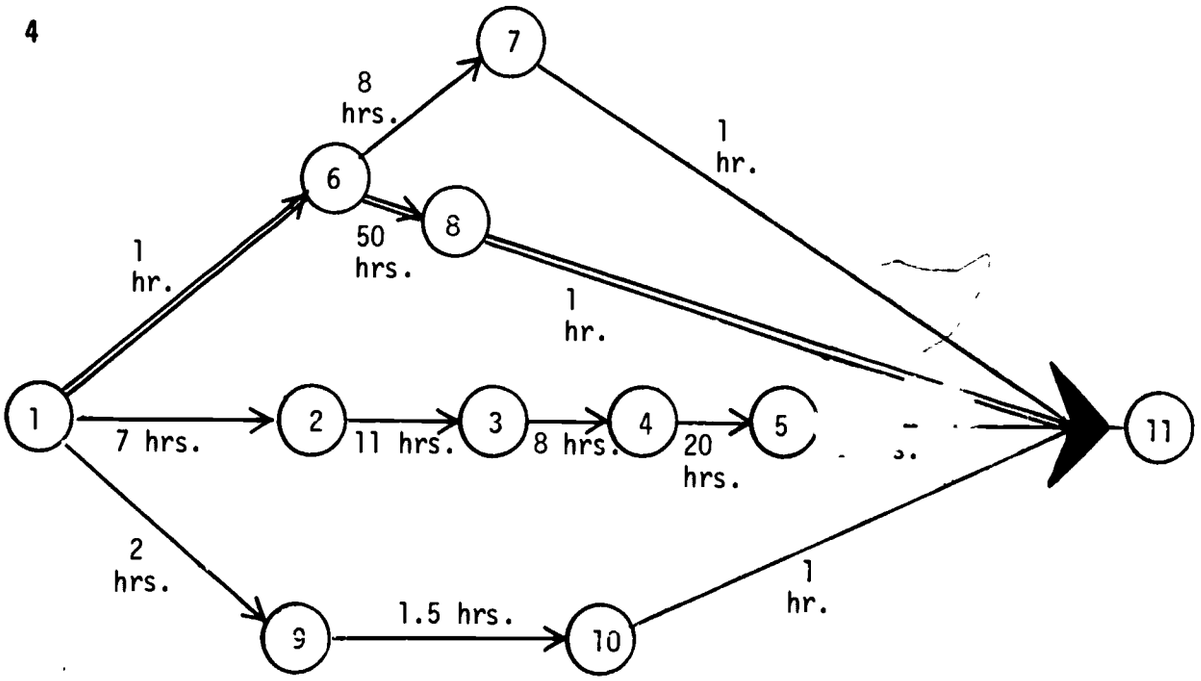
[1] An "event," which is represented on the charts on the following pages by a circle, is a specific and definable point in time indicating the start or completion of an activity. An event does not use time, personnel, or resources.

[2] An "activity," which is represented on the charts on the following pages by a line between events, is a job using up resources and personnel over a specified period of time. A double line indicates the "critical path," that is, the sequence of events and activities which is expected to take more time for completion than other events or activities.



Event Identification

1. Authored material submitted to programer
2. Authored material prepared for keypunching
3. Authored material keypunched
4. Card deck assembled and listed
5. Initial debugging completed
6. Image planning forms sent to graphic artist
7. Slide processing completed
8. Image preparation completed
9. Audio messages edited
10. Audio messages typed
11. Author review completed

Activity

1-2:
1. Edit author's material (i.e., clear for keypunch operator)
2. Program unique CWII statements
3. Indicate cards for mass production
4. Specify locations in program for audio and image

2-3:
1. Material keypunched
2. Cards proofed

3-4:
1. Card deck built
2. Cards assembled
3. Assembled material listed

4-5:
1. Check on-line material with original sheets
2. Make necessary corrections

5-11:
1. Author reviews material on-line (audio, image, text)
2. Author notes revisions

1-6:
1. Xerox image requests plus file copies
2. Record image numbers
3. Original image request to graphic artist

6-7:
1. Slides taken
2. Slides processed

6-8:
1. Images evaluated and planned
2. Images prepared

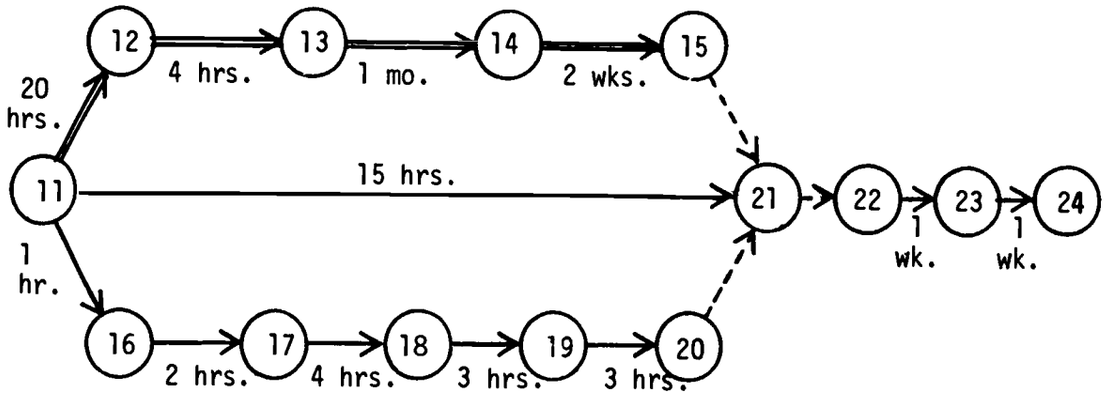
7-11:
1. Author reviews slides
2. Author notes revisions

8-11:
1. Author reviews images
2. Author notes revisions

1-9:
1. Audio messages edited for typist
2. Symbolic names assigned

9-10:
1. Audio messages typed and proofed

10-11:
1. Author reviews audio messages
2. Author notes audio revisions



Event Identification (Continued)

11. Author review completed
12. First revision of images completed
13. Images photographed
14. Answer print received
15. Image copies received
16. First revision audio messages typed
17. Audio messages recorded
18. Student audio tape completed
19. Audio recordings debugged
20. Audio tape copies made
21. Program revisions and debugging completed
22. Students scheduled - 1st group
23. Students complete trial run
24. Author review of student records and comments completed

Activity (Continued)

11-12:
1. Author notes image revisions
2. Graphic artist makes revisions

12-13:
1. Images photographed

13-14:
1. Film sent for developing
2. Original reel received
3. Original reel matched to address track and returned to processor for answer print
4. Answer print received

14-15:
1. Answer print approved
2. Copies ordered
3. Copies received

11-16:
1. Author notes audio revisions
2. Prepare audio revisions for typist
3. Type audio revisions and proof
4. Technical specifications noted on script

16-17:
1. Schedule audio recording
2. Make narration tape

17-18:
1. Punch cards for symbol table
2. Create symbol table
3. Create master tape by audio assembly
4. List symbol table
5. Create working master tapes

18-19:
1. Listen to audio messages
2. Audio substitution into segment

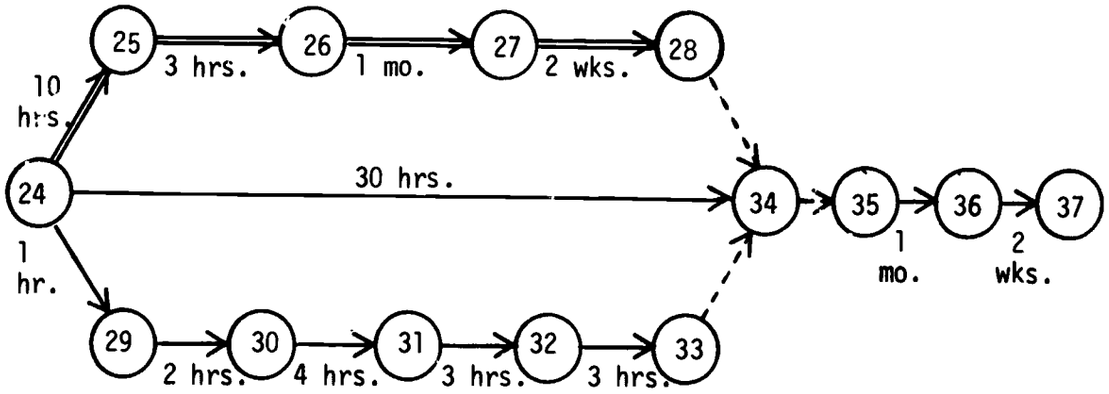
19-20:
1. Request copies of tape
2. Copy tapes

11-21:
1. Make programing revisions
2. Debug program

21-22:
1. Schedule students

22-23:
1. Students go on-line
2. Student performance data collected
3. Student comments collected

23-24:
1. Comments sorted
2. Comment cards given to author
3. Student performance data given to author
4. Author reviews comments, student records



Event Identification (Continued)

24. Author review of student records and comments completed
25. Second revision of images completed
26. Images photographed (or errata noted)
27. Answer print completed
28. Copies of image reel received
29. Second revision of audio prepared
30. Audio messages recorded
31. Student audio tapes completed
32. Audio messages debugged
33. Audio tape copies made
34. Program revisions and debugging completed
35. Students scheduled - 2nd group
36. Students complete trial run
37. Author review of student records and comments completed

Activity (Continued)

24-25:
1. Author notes revisions
2. Graphic artist remakes images

25-26:
1. Images photographed

26-27:
1. Film sent for developing
2. Original reel received
3. Original reel matched to address track and returned to processor for answer print
4. Answer print received

27-28:
1. Answer print approved
2. Copies ordered
3. Copies made

24-29:
1. Audio messages re-edited
2. Audio retyped

29-30:
1. Schedule audio recording
2. Make narration tape

30-31:
1. Punch cards for symbol table
2. Create symbol table
3. Create master tape by audio assembly
4. List symbol table
5. Create working master tape

31-32:
1. Listen to audio messages
2. Request audio substitution

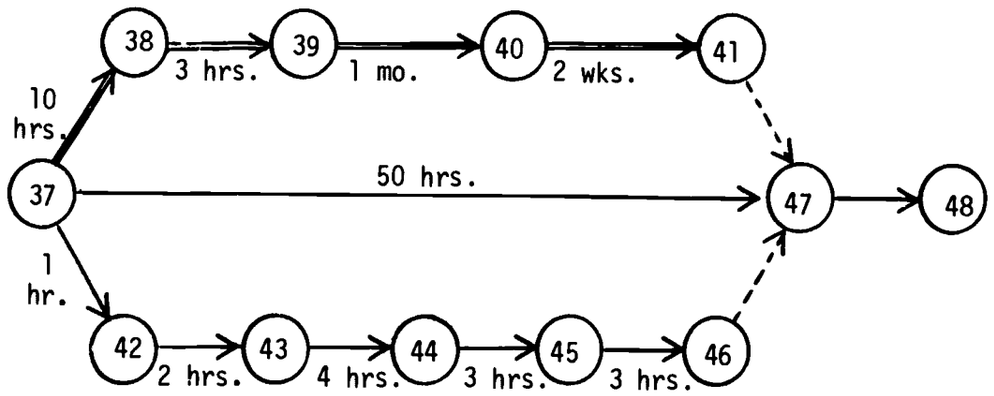
32-33:
1. Copy tapes

24-34:
1. Revise program
2. Debug program

34-35:
1. Schedule students

35-36:
1. Students on-line
2. Student performance data collected

36-37:
1. Student records run
2. Student records reviewed



Event Identification (Continued)

37. Author review of student records and comments completed
38. Final revisions of images completed
39. Final revisions of images photographed
40. Final answer print approved
41. Image copies received
42. Final version of audio text prepared
43. Final version of audio messages recorded
44. Student audio tapes completed
45. Audio debugging completed
46. Audio tape copies made
47. Program revisions and debugging completed
48. Preparation of course completed

Activity (Continued)

37-38:

1. Author notes revisions
2. Graphic artist revises images
3. Author proofs revised images

38-39:

1. Images (revisions) photographed

39-40:

1. Film sent for developing
2. Original reel received
3. Original reel is matched to address track and returned to processor for answer print
4. Answer print received

40-41:

1. Answer print approved
2. Copies ordered
3. Copies received

37-42:

1. Author notes audio revisions
2. Audio revisions prepared for typist
3. Audio revisions typed and proofed

42-43:

1. Schedule audio recording
2. Make narration tape

43-44:

1. Punch cards for symbol table
2. Create symbol table
3. Create master tape by audio assembly
4. List symbol table
5. Create working master tapes

44-45:

1. Listen to audio
2. Request audio substitution

46-47:

1. Request copies of tape (audio)
2. Make tapes

37-47:

1. Revise program
2. Debug program

Table 1

Time Required to Complete Activities
Shown in PERT Chart:
Cathode Ray Tube Programing, Overall Programing

Activity	Programer	Graphics Artist	Technician	Clerical	Author	Keypunch	Computer Operator	Other
1-2	7 hrs.							
2-3						11 hrs.		
3-4	7 hrs.						1 hr.	
4-5	10 hrs.					10 hrs.		
5-11					2 hrs.			
11-21	5 hrs.					10 hrs.		
22-23							1 hr.	5 hrs. record comments
23-24					40 hrs.			
24-34	10 hrs.						2 hrs.	
35-36						20 hrs.		
36-37					80 hrs.			
37-47	20 hrs.						20 hrs.	
47-48			*	*		30 hrs.	*	

*Less than one hour

Table 2

Time Required to Complete Activities
Shown in PERT Chart:
Audio Programing

Activity	Programer	Graphics Artist	Technician	Clerical	Author	Keypunch	Computer Operator	Other
1-9	2 hrs.							
9-10				1 1/2 hrs.				
10-11					1 hr.			
11-16				1 hr.				
16-17								2 hrs. narrator
17-18			1 hr.				3 hrs.	
18-19	3 hrs.							
19-20			3 hrs.					
24-29				1 hr.				
29-30								2 hrs. narrator
30-31			1 hr.				3 hrs.	
31-32	3 hrs.							
32-33			3 hrs.					
37-42				1 hr.				
42-43								2 hrs. narrator
43-44			1 hr.				3 hrs.	
44-45	3 hrs.							
45-46			3 hrs.					

Table 3

Time Required to Complete Activities
Shown in PERT Chart:
Image Programing

Activity	Programer	Graphics Artist	Technician	Clerical	Author	Keypunch	Computer Operator	Other
1-6	1 hr.							
6-8		50 hrs.						
8-11					1 hr.			
6-7								8 hrs. Photo-grapher
7-11					1 hr.			
11-12		20 hrs.			1 hr.			
12-13	4 hrs.		4 hrs.					4 hrs. Photo-grapher
13-14			1 hr.					1 mo. ind,mail, etc.
14-15			1 hr.		1 hr.			2 wks.
24-25		10 hrs.			1 hr.			
25-26	3 hrs.		3 hrs.					3 hrs. film lab
26-27			1 hr.					1 mo.
27-28			1 hr.		1 hr.			2 wks.
37-38		10 hrs.			1 hr.			
38-39	3 hrs.		3 hrs.					3 hrs.
39-40			1 hr.					1 mo.
40-41			1 hr.		1 hr.			2 wks.

Table 4

Summary of Labor Required to Produce One Hour of Tutorial CAI Given Clean Autnor Program Sheets

Task	Time
Programer	81 hrs.
Graphic Artist	90 hrs.
Technical Support	28 hrs.
Clerical	4 1/2 hrs.
Author	131 hrs.
Keypunch Operator	81 hrs.
Computer Operator (Specific Tasks - Not Day-to-Day)	33 hrs.
Others:	
Narrator	6 hrs.
Comment Recorders	5 hrs.
Photographer	18 hrs.
Film Lab Processor	variable
Computation Center - Time for Student Records	variable

SECTION TWO

TECHNIQUES AND CONVENTIONS USED IN PLANNING AND CARRYING OUT THE PROGRAMING FOR CARE 1

Course Preparation

It is essential that an efficient procedure for processing authored material be devised as soon as possible, for the writing and programing of text takes up most of the time in the first phase of course development. For instance, basic questions about translating the author's text into usable input must be answered early: How much Coursewriter language should authors be required to know? Must the author indicate restart points? What percentage of the course should be developed by the "deck-building" method?[1] What specific operating procedures should be set up between the programer and key-punch operator?[2] When should "fp's" (image statements) and "aup's" (audio statements) be inserted? What system should be used for labeling? What system should be used for coding "ep identifiers?" (See Ep Identifiers)

The procedure finally adopted for CARE 1 included four basic steps. First, the author wrote out instructional blocks of material as well as directions to the programer on specially designed program sheets (see Fig. 1). The directions usually related to the placement of images and audio messages and to the location of branching statements. Though authors were not required to know Coursewriter, they were asked to work within certain broad formating limits.[3]

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[1] "Deck building" is a method for producing a stack of punched computer cards which are then assembled into the computer. On the IBM 1500 System, course material can also be input "on line." But this method is slower, and it degrades the system for use by others.

[2] For instance, should coding and text be punched together? Should there be an "enter" after every line of text? Should all feedback be in capital letters to set it off from other text? How should underlines be handled?, etc.

[3] It is probably a good idea to have authors submit a few of their first programing sheets so that errors and problems can be detected before they write too much.

LABEL _____

COLUMN

PAGE _____

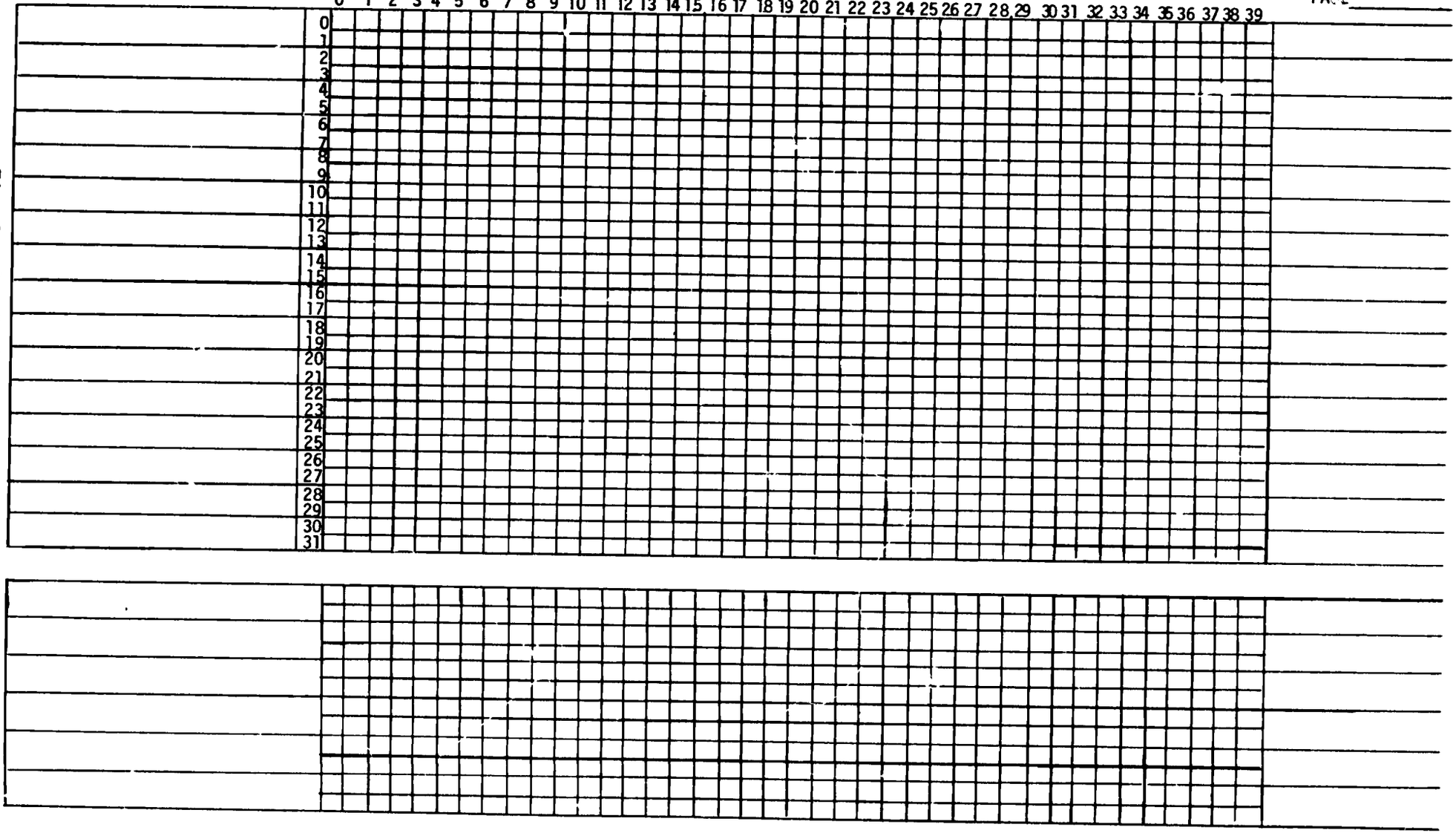

Fig. 1. Sample Programing Sheet.

In the second step, the programer edited the instructional text for the keypunch operator. That is, he cleared up illegibilities and obvious grammatical and typographical errors.[4] He also penciled in any unique Coursewriter statements not available in a supply of mass-punched computer cards used later in the "deck-building" process (explained in step four). It was found that the amount of editing and "penciling in" depended, to a large extent, on the competency of the keypunch operator and on the efficiency of the procedure followed by the operator and programer. If both competency and efficiency were high, certain unspecified assumptions could be made. If not, the programer was required to detail instructions. Error-free program sheets at this early stage of development were essential.

In step three, the keypunch operator, using the edited program sheets, prepared a primary deck of punched cards. They consisted mainly of textual material and of unique Coursewriter statements. These two types of cards were punched separately and were later combined by the programer during deck-building.

In the fourth step, the programer had two responsibilities: deck-building and initial, on-line debugging. In deck-building, the programer intercalated into the primary deck unique Coursewriter statements and the pre-punched statements most commonly used.[5] In CARE 1, each line of text was preceded by a single dt (display text) card. But, because there was a considerable amount of text, execution time was slowed down and disk size was considerably expanded. If the alternative usually suggested is followed in the future, that is, if one dt card is used for several lines of text, it should be remembered that the keypunch operator will be required to insert a return-index after each line of text.

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[4]Because illegibility can cost time and money, it would seem wise to show authors as early as possible how self-defeating it can be.

[5]Such cards might be dt's (display text), pa's (pause), fn's (functions), de's (display erase), etc.

After the completed CARE 1 deck was assembled into the computer, the programer's second responsibility was initial on-line debugging. In this step the objective was to insure that assembled material and course flow corresponded to the specifications laid down by the author on his programing sheets.

Answer Processing

Since the nature of a student's answers to questions is a critical factor when judging the effectiveness of a course, and since so much Coursewriter coding is used in processing these answers, it is important that an efficient answer processing procedure be devised early. Whether one uses the conventional answer set (ca's, wa's, and un's) or uses functions to process answers will depend, to a large extent, on the nature of course material. For instance, a course in mathematics, in which number answers are simply right or wrong, will generally use ca's and wa's. By adding an edit function to handle extraneous correct characters, almost every situation can be accounted for. In a course such as CARE 1, however, in which answers are generally words, phrases, sentences, and combinations of these, functions must be used. In CARE 1, a combination of two such functions--mark (mk) and evaluate string (es)--provide a degree of flexibility not possible with ca's and wa's. Because these functions require the buffer loading of key words, partial answers in multi-word responses are accepted. Using functions also reduces the need for anticipating word order and/or extraneous characters. In addition, by loading a buffer with fractional parts of words (matur, for instance, will match mature, maturation, or maturity), and by using an edit function to handle anticipated extraneous characters from a student's response, a certain percentage of misspelled correct answers is accepted.

Unfortunately, "leading characters" in a response match cannot be handled correctly by function es. Using the example above, the program will, for instance, accept immature as a correct match for the buffer load matur. In addition, if functions are used to process numerical answers, extraneous leading numbers will be accepted--128 will be marked correct for 8. When this situation can be forseen, function mark character string (mc) should be used. Or one can simply revert to ca's and wa's for numbers.

Questions which elicit "open-ended" responses should follow one of two procedures: one which provides for the automatic movement of the cursor to the next line (i.e., after forty characters are typed), or the other which lets the student move the cursor to the next line by pressing the carriage return and index keys. The former procedure allows for an unlimited response.

The latter limits the response to 99 characters or to the capacity of the response buffer. It is advisable to use either one or the other of these two procedures, since students are often confused by instructions for two procedures.

If an author requests that students' responses be timed, he should be told that in some cases, this will cause confusion. If the time allowed is too short, for instance, the time-out feedback will flash on the screen before the slower student has had a chance to consider his answer and make a response. Obviously, if the time is made too long, the feedback will rarely be shown and will be of value to no one.

Also, there is the problem of unwittingly "structuring" a student's answers in a completion question where underlines of so many spaces are used to indicate blanks to be filled in. To reduce such structuring in CARE 1, cursors were usually moved to below the last line of a question, away from the blank.

It will also be necessary to warn authors of potential problems in frames requiring multiple light-pen responses. It is generally difficult, for example, to match the rhythm of the system speed with the rhythm of the student's response action. Also, when specifying light pen boxes for the CRT, authors should be asked to locate these boxes at least two rows apart. This will prevent the recording of incorrect choices because of a student's careless aim with the light pen.

Automatic Subroutine Access - (ASA)

The Automatic Subroutine Access (ASA) is a routine developed originally for the Commonwealth CAI Consortium project. It was altered somewhat for CARE 1 by the addition of the following five course modifications available to students and proctors:

1) comment at any frame; (c)
2) replay the most recent audio message; (a)
3) reshow the most recent image; (f)
4) skip to a new frame within a segment; (;)
5) transfer from one segment to another. (t)

ASA is accessed when an "sp" appears at the lower right corner of the CRT. At that time the student (or proctor) types an alternated coded "q" (that is, he holds down the ALTN CODING key and depresses the "q") and ENTERS it.[6] He then types a code corresponding to one of the options shown above. Options 1, 2, and 3 are designed for the student's use. Options 4 and 5 are for the proctor's use.

Comment

If the student types a "c," he is branched to a routine which allows him to type a comment of any length. All comments are recorded at the proctor station along with the segment number and the course label at which the comment was made. If the student's "performance" is being recorded, this information can also be stored in a student's records.

Replay Audio

If an "a" is typed, the most recent audio message is replayed. If the message contains emphasis points, these are passed over. (Also see Audio)

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[6] A student ENTERS his response, that is, he transmits it to the computer, by holding down the ALTN CODING key while pressing the SPACE BAR.

Image Reshow

If an "f" is typed, the shutter will be opened on the image last shown.

Skip

If an alternate coded semi-colon is typed, the proctor can skip the student to another frame within the same segment by typing in the appropriate label. This is done generally when a student wants to review something already covered.

Transfer

If a "t" is typed, the proctor can transfer the student to any other course segment. After typing the "t," the proctor must type the number of the segment to which he wishes to transfer.

Audio

If audio is to be used in a course, an efficient method for handling and processing messages is needed. First, though, a competent "voice" must be found. Then a scheme for labeling messages and marking such things as emphasis points must be devised. CARE 1 audio, consisting of approximately 450 messages of varied lengths and complexities, was recorded almost completely by a local professional radio announcer. There were four main stages through which audio preparation passed from original writing until completed recording:

1) Authors began by writing or typing messages on specially prepared 8 1/2 x 14-inch forms.[7] They also included on these forms special directions for use of, and location of, the message within an instructional frame.

[7] See Figure 2.

AUDIO MESSAGE PROGRAM SHEET - CAI Laboratory

Course Name: _____ Segment: _____ Symbol Table Name: _____ Date _____ Page 1

Author: _____ Recorded by: _____ Date: _____ Assembled by: _____ Date: _____

Programmer: _____

Message N.	Course Label	Ans. Code	Code	Symbolic Name	Set I.D.	No. Emp. Mks.	Track	Address	MESSAGE

6/70

Fig. 2. Audio Message Program Sheet.

2) The programer's responsibility in stage two was to prepare the text of the messages for a typist. This included proofreading and editing as well as the insertion of emphasis points[8] (if needed) and the assigning of message numbers, course labels, answer codes (ca's, wa's, un's), symbolic names,[9] track numbers, and set identifiers.[10]

3) In step three, a typist prepared the messages in triplicate (one copy each for the announcer, the programer, and the laboratory file).

4) The original typed copy of the audio messages was then sent to the system manager. The system manager penciled in technical instructions for the announcer. These related to location of "group marks" and beginnings and endings of messages or to information pertinent to symbol table production.

After the four preparatory stages, audio messages were then, 1) recorded on a "narration" tape, and 2) transferred to "master" tapes from which copies were eventually made.

Messages were then arranged in an "overlapped" tape scheme to provide for the efficient restarting of students (see Restarts). The scheme, which uses eight tapes, is shown in Figure 3.

---

[8]An emphasis point produces an interruption in the continuity of an audio message. At such time, another terminal operation is engaged (i.e., either an image appears or the CRT text changes). Immediately after this operation, the audio message continues from the point of interruption until either another emphasis point or the end of the message is reached.

[9]A symbolic name is the identifying label for each audio message. Because of 1500 System requirements, this name consists of no more than five characters, the first two being alphabetic characters and the last one, two, or three being Arabic numerals. For purposes of coordination in CARE 1, the symbolic names were modelled after frame labels. For example, in Chapter 13, Segment 92 (with frame labels beginning with jn01a), symbolic names might be jn01, jn02, jn021, jn022, etc.

[10]A set identifier is a symbol (letter or number) indicating that two or three audio messages are to be grouped together at an identical address on different tracks of a tape. This method was used generally for feedback messages when it was not possible to anticipate which message in the answer set would be accessed first.

CARE 1 AUDIO TAPES

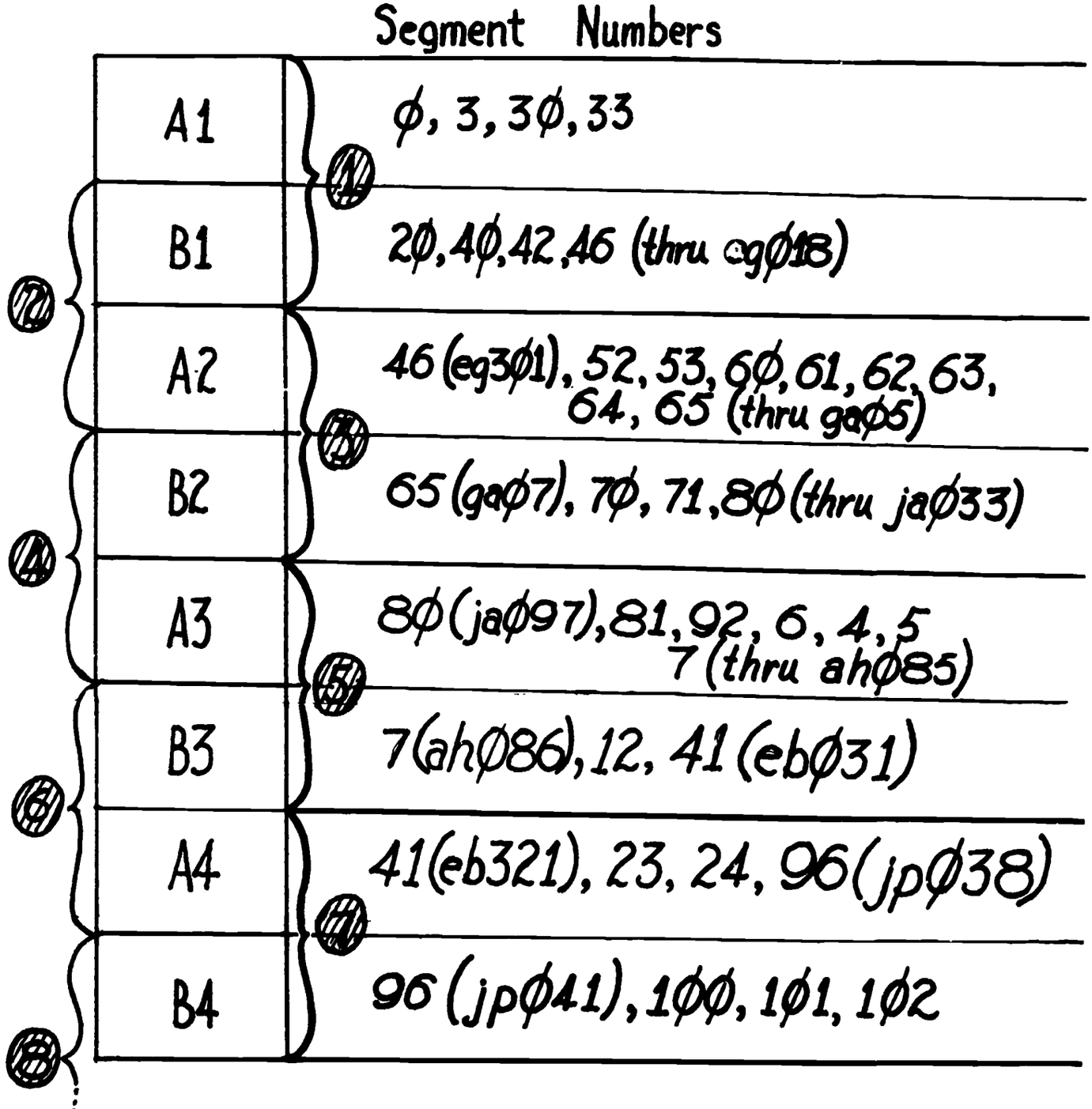


Fig. 3. Overlapped audio tape scheme.

After audio messages were recorded on a narration tape and transferred to master tapes, the audio messages were then, 1) assembled into the CARE 1 course, and 2) proofed on line by programers and authors.

Because it was considered desirable to let students replay audio messages, special techniques were devised, not only to allow them to make their choices known but also to facilitate the programing of necessary Coursewriter statements. As to the first, the students simply followed the procedure they used when "commenting." (See ASA; Comment) The technique for programing Coursewriter statements, however, involved two specially prepared macros: psaup and psaupe. The first macro, consisting of four statements, was "called" in the program for each non-emphasis-point audio message or for the beginning of a message with one or more emphasis points. The second, consisting of five statements, was called at those locations in the program where an emphasis point occurred.

When the replay operation is engaged, the entire audio message is repeated. After the replay, the course flow reverts immediately to that point in the course where the replay was requested. In the replay of audio messages with emphasis points, the emphasis points are passed over so that only the text of the message is heard.

Since the positioning of an audio message is critical to the smooth operation of a course, a few conventions were established toward that end. As a general rule, an audio position statement was inserted in the course immediately after each audio message was played, if the next audio message was known and if it did not begin immediately after the end of the last message. This is especially critical if a single frame includes a cluster of messages, either as different types of feedback and/or as introductory material.[11]

Audio position statements were also inserted when necessary at restart points. (See Restarts) If this was done in anticipation, that is, if the message was not actually played for sometime, the procedure is a time saver.

---

[11]Though terminal operation does not stop while a tape is positioning, it does stop if a new position statement is executed while the other is in process.

If, after a restarting, however, an audio message is needed immediately or almost immediately, a positioning delay is inevitable. The delay will be pronounced if the message is located any distance from the beginning of the tape. Except in this situation, audio positioning usually insures against delays in course flow.

Because a student hears audio messages through earphones, and because it is often uncomfortable to wear them over an extended period of time, it was thought advisable to inform students when they might take them off. As a general rule, an announcement to this effect is displayed on the CRT if approximately ten or more non-audio frames appear at any time during the course. Announcements to put on earphones again, of course, also is included. At restart points (see Restarts), it then became necessary for the programer to determine if earphones would be needed. A switch at a restart point is then turned on or off depending upon the condition. If needed, an announcement appears on the CRT during the display of an "on-routine" frame. (See On-routine)

Biographical Information Blank - (BIB)

Biographical information is gathered on every student taking CARE 1 by means of a question and answer section called Biographical Information Blank (BIB). BIB contains a total of thirty-nine questions derived from OE Form 7214 (Participant Data Summary). A student is asked to give, among other things, his name, address, social security number, his racial background, academic degrees, teaching experience, and the ethnic make-up of classes he teaches. Answers are either typed or indicated by means of a light pen and are "held strictly in confidence." No audio or images are used.

BIB appears in CARE 1 immediately after "How To" and, therefore, right before the first instructional chapter of the course entitled "Overview."

The data gathered in this manner is summarized on the form shown in Fig. 4.

DEPARTMENT OF HEALTH, EDUCATION, AND WELFARE
OFFICE OF EDUCATION
WASHINGTON, D.C. 20202

BUDGET BUREAU NO. 51-R0752
APPROVAL EXPIRES: 10/31/71

PARTICIPANT DATA SUMMARY

(Parts C, D, and F, Education Professions Development Act
Title V, P.L. 89-329, as amended)

1. OE PROJECT NUMBER: 002062

2 NAME OF SPONSORING INSTITUTION OR AGENCY: The Pennsylvania State University

3. STATE: Pennsylvania

4. a. NUMBER OF PARTICIPANTS TO BE TRAINED IN THE PROJECT: 3,000

b. NUMBER OF PARTICIPANTS COVERED BY THIS SUMMARY REPORT: 137

DATA ON PARTICIPANTS: Ridgway, Pennsylvania

5. SEX

a. Male	61
b. Female	76

6. AGE

a. under 25	53	d. 35-39	8	g. 50-54	5
b. 25-29	27	e. 40-44	10	h. 55-59	12
c. 30-34	13	f. 45-49	9	i. 60 and over	

7. PARTICIPANTS BY WHETHER OR NOT THEY ARE VIETNAM ERA VETERANS

a. Vietnam era veterans	2
b. Not Vietnam era veterans	135

8. RACIAL OR ETHNIC BACKGROUND

a. Negro or black		d. American Indian	
b. Puerto Rican		e. Oriental	
c. Mexican-American	5	f. Other than the above	132

9. PARTICIPANTS BY WHETHER THEIR INCOMES ARE, OR WERE BEFORE THEY ENROLLED IN THIS PROJECT, BELOW THE POVERTY LINE

a. Below poverty line	
b. Not below poverty line	

10. GEOGRAPHIC DISTRIBUTION OF PARTICIPANTS *(by State of employment prior to this project)*

a. Ala.		k. Ga.		u. Md.		ee. N. J.		ao. S. C.		ey. Wyo.	
b. Alaska		l. Hawaii		v. Mass.		ef. N. M.		ap. S. D.		ez. Canal Zone	
c. Ariz.		m. Idaho		w. Mich.		eg. N. Y.		aq. Tenn.		ba. Guam	
d. Ark.		n. Illinois		x. Minn.		eh. N. C.		ar. Texas		bb. Puerto Rico	
e. Cal.		o. Indiana		y. Miss.		ai. N. D.		as. Utah		bc. Virgin Is.	
f. Colo.		p. Iowa		z. Mo.		aj. Ohio		at. Vt.		bd. Pacific Trust Territories	
g. Conn.		q. Kansas		aa. Mont		ak. Okla.		au. Va.			
h. Del.		r. Ky.		ab. Nebr.		al. Oreg.		av. Wash.		be. Overseas Dep. Schools	
i. D. C.		s. La.		ac. Nevada		am. Pa.	137	aw. W. Va.			
j. Fla.		t. Maine		ad. N. H.		an. R. I.		ax. Wisc.		bf. Foreign	

11. HIGHEST DEGREE EARNED

a. NONE	b. H. S. DIPLOMA	c. BACHELOR'S	d. MASTER'S	e. ED. D.	f. PH. D.
3	15	94	25		

12. OCCUPATIONAL BACKGROUND

a. Currently employed *(or within the past 5 years employed)* in the field of education	130	d. Never previously employed in the field of education by whether they were	
b. Previously employed in the field of education, but not within the past 5 years	5	1. Employed in other professions requiring an academic degree	1
c. Never previously employed in the field of education	2	2. Holding an academic degree but not working	
		3. Not holding an academic degree	1

13. TOTAL YEARS OF TEACHING OR OTHER EMPLOYMENT IN THE FIELD OF EDUCATION

a. NONE	b. 1-4 YEARS	c. 5-9 YEARS	d. 10-14 YEARS	e. 15-19 YEARS	f. 20 OR MORE
7	71	27	12	6	14

14. PRIMARY POSITION OR EMPLOYMENT STATUS AT PRESENT, OR IMMEDIATELY PRIOR TO PROJECT

a. IN A PRESCHOOL, ELEMENTARY OR SECONDARY SCHOOL OR SCHOOLS, OR LOCAL EDUCATION AGENCY: 132

1. Teacher	115	5. Instructional media *(incl. librarians)*	1	b. OTHERWISE EMPLOYED	5
2. Administrator	10	6. Education aide or paraprofessional		1. Teacher trainer *(in institution of higher education)*	
3. Supervisor		7. School volunteer	2	2. In State educ. agency	
4. Pupil personnel specialist	3	8. Other education position	1	3. Non-education position	4
				4. Student	5

OE FORM 7214, 6/70 — REPLACES OE FORM 7214, 6/69, WHICH IS OBSOLETE.

Fig. 4. OE Form 7214, Participant Data Summary.

DATA ON SCHOOLS OF PARTICIPANTS

(NOTE: Distribute into each of the following items (15, 16, 17, 18, 19a, 19b, 19c, 19d, and 19e) only the number of participants who have been classified in item 14a, by the category in each item which best describes the nature of their schools. Exclude participants classified in item 14b.)

15. SCHOOL OR SYSTEM, BY CONTROL

a. Public	108
b. Nonpublic	24

16. GRADE LEVELS WITH WHICH THE PARTICIPANTS' ASSIGNMENTS USUALLY RELATE

a. Preschool	2	d. Jr. High (7-9)	12	g. Elem. & Sec.	4
b. K - Gr 3	18	e. Sr. High (10-12)	30	h. Post-Sec. Vocational	1
c. Elem (K-6)	49	f. Secondary (7-12)	16	i. Adult Education	

17. AREA OF SERVICE OF SCHOOL OR SYSTEM WHERE EMPLOYED *(predominant characteristic)*

a. Rural or small town - general population	122	d. Urban - poverty area	
b. Rural or small town - poverty area	6	e. Suburban	2
c. Urban - general population	2		

18. STUDENT BODY OF SCHOOL *(or schools)* **IN TERMS OF THE PERCENT WHO COME FROM FAMILIES AT OR BELOW THE POVERTY LINE**

a. 0%	1	d. 20-29%	22	g. 50-59%		j. 80-89%	1
b. 1-9%	33	e. 30-39%	19	h. 60-69%	3	k. 90-100%	
c. 10-19%	40	f. 40-49%	12	i. 70-79%	1		

19. STUDENT BODY OF SCHOOL *(or schools)* **IN TERMS OF THE PERCENT WHO COME FROM SPECIFIED MINORITY RACIAL OR ETHNIC BACKGROUNDS**

A. NEGRO OR BLACK		B. PUERTO RICAN		C. MEXICAN-AMERICAN		D. AMERICAN INDIAN		E. ORIENTAL	
a. 0%	128	a. 0%	131	a. 0%	130	a. 0%	125	a. 0%	121
b. 1 - 9%	4	b. 1-9%	1	b. 1-9%	2	b. 1-9%	7	b. 1-9%	11
c. 10-19%		c. 10-19%		c. 10-19%		c. 10-19%		c. 10-19%	
d. 20-29%		d. 20-29%		d. 20-29%		d. 20-29%		d. 20-29%	
e. 30-39%		e. 30-39%		e. 30-39%		e. 30-39%		e. 30-39%	
f. 40-49%		f. 40-49%		f. 40-49%		f. 40-49%		f. 40-49%	
g. 50-59%		g. 50-59%		g. 50-59%		g. 50-59%		g. 50-59%	
h. 60-69%		h. 60-69%		h. 60-69%		h. 60-69%		h. 60-69%	
i. 70-79%		i. 70-79%		i. 70-79%		i. 70-79%		i. 70-79%	
j. 80-89%		j. 80-89%		j. 80-89%		j. 80-89%		j. 80-89%	
k. 90-100%		k. 90-100%		k. 90-100%		k. 90-100%		k. 90-100%	

AREA OF SPECIALIZATION *(If employed in an institution of higher education)*

20. PARTICIPANTS EMPLOYED IN INSTITUTIONS OF HIGHER EDUCATION - THOSE PARTICIPANTS DISTRIBUTED IN THE FIRST CATEGORY OF ITEM 14b, AS "TEACHER TRAINERS" - BY AREA OF SPECIALIZATION

a. ARTS OR SCIENCES	b. EDUCATION	c. OTHER

TYPE OF POSITION FOR WHICH PARTICIPANTS ARE PREPARING

21. ALL PARTICIPANTS BY WHETHER THIS PROJECT IS PREPARING THEM TO ENGAGE IN A DIFFERENT TYPE OF POSITION

a. Preparing for same type of position as at present *(as reported in item 14)*	113
b. Preparing for a different type of position *(include teachers who are preparing to teach a different subject)*	24

c. Participants in category b. above by type of position being prepared for

1. Teacher *(of a different subject)*	24	6. Educational aide or paraprofessional	
2. Administrator		7. School volunteer	
3. Supervisor		8. Other educational position *(in a school)*	
4. Pupil personnel specialist		9. Teacher trainer *(in an institution of higher education)*	
5. Instructional media specialist *(including librarian)*			

Fig. 4. OE Form 7214, Participant Data Summary (cont'd.).

Case Studies

If an author requests that on-line exercises be developed to give the student practice in using the principles covered in a course, the CARE 1 "case studies" might prove useful as models.

Chapter 21 of CARE 1 consists of three segments of on-line material. Each segment presented a case study of a child with a problem that interferes with his educational progress. The students are presented information about each child and are required to make decisions about that child as in a regular classroom situation.

The Decision Process Flowchart is used as an organizational guide in presenting the case studies. The students first survey the children (step 2 in the Decision Process) in a hypothetical first grade classroom by examining the cumulative records of 15 children. The cumulative records are presented in the Handbook. On the basis of this information the students single out or "screen out" for further diagnosis (step 3) three children who seem to have problems that would most likely interfere with their school progress.

The students then gather diagnostic information (step 4) for each of these three children in turn. The following data are prepared in advance and presented via the CRT and the Handbook:

Child 1:
- a. observational record
- b. academic report
- c. results of Denver Developmental Screening Test
- d. results of group intelligence test
- e. results of hearing test
- f. interview with parents
- g. two reports of school psychologist

Child 2:
- a. observational record
- b. academic report
- c. report of physical examination by school nurse
- d. results of group intelligence test
- e. interview with parents

Child 3:
- a. observational record
- b. academic report
- c. sociograms
  - 1. work group
  - 2. play group
- d. self-report inventory
- e. results of Metropolitan Readiness Test

The actual order of presentation of the diagnostic data for each child is determined largely by students' responses.

The students document the information gathered by completing a Teacher Referral Statement for each child. When the students judge the information to be adequate (step 5), they are required to decide (step 6) whether to refer the child to a specialist or to modify the child's educational program. The former course of action requires the students to select the appropriate specialist (step 8), while the latter requires them to select the appropriate modification procedures based on the child's behaviors (step 7).

These case studies comprise the final portion of the course and were developed primarily to integrate the information and procedures presented in the previous chapters and to allow the students to apply their knowledge and skills in a situation somewhat approximating a classroom environment.

Dynamic Transfer Routine - (DTR)

Since segment sequencing is often revised throughout the developmental phase of a course, the dynamic transfer routine (DTR) was developed. This routine enables a proctor to quickly and efficiently alter segment sequencing. By signing on to the first segment in a course and executing the DTR, the proctor can change the transfer instruction under labels "end," "jump," and "backup" which appear at the end of each segment. Under labels "end" and "jump" there are transfer statements to the next segment. Under label "backup" there is a transfer statement to the previous segment.

EP Identifiers

Though it is regrettable, there are almost no studies on the effects that CAI and its special modes of presentation have on a student's response to questions. As a result, there are no solid guidelines for determining whether it is better to elicit light pen or keyboard responses or whether, for instance, it is better to accompany questions with an audio message or an image.

Some course planners have tried to accumulate data on this by coding the student's "ep identifiers" (answer identifiers) and relating them to the nature of questions to see if any generalizations can be made. In CARE 1, these codes were inserted by the programer before the card punching operation and were designed to discriminate between a light pen response and a keyboard response, a single response and a multiple response, a single-letter response (e.g., the typing of a, b, c, or d) and an "open-ended" response (a typed answer with no limit on length). Responses to questions supplemented by an image or by an audio message were also separately identified as well as the number of lines of text in each question. A response identifier, then, containing as many as ten character positions, looks something like Figure 5 below.

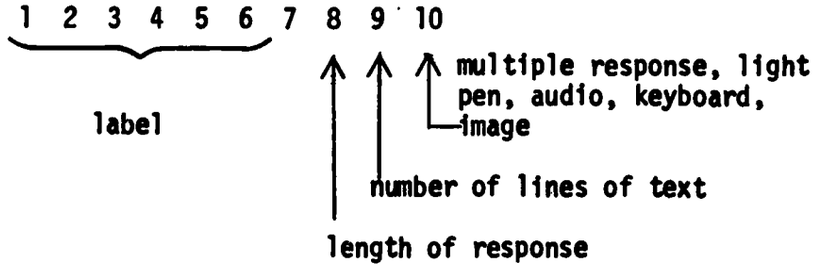


Fig. 5. Response identifier format.

Since each of the ten positions limits the code to one character, letters A through Z, followed by numerals 0 through 9, were used. This procedure provided for 35 different identifiers for each position. An exception was position 9. Since the number of lines of text on the CRT rarely exceeds 9, the numerals 0 through 9 were found to be sufficient. Figure 6 was used for quick letter-to-number conversion

For example, if an anticipated correct answer is 6 characters long, the programer would fill in the 8th position in the ep identifier with a G; if the question consisted of 3 lines of text, position 9 would contain a 3; if the student's response was by means of light pen and there was an image shown at the time, position 10 could contain a 2. Coding for all possible combinations in position 10 is shown in Figure 7.

0--A	9--J	18--S	27--1
1--B	10--K	19--T	28--2
2--C	11--L	20--U	29--3
3--D	12--M	21--V	30--4
4--E	13--N	22--W	31--5
5--F	14--O	23--X	32--6
6--G	15--P	24--Y	33--7
7--H	16--Q	25--Z	34--8
8--I	17--R	26--0	35--9

Fig. 6. Table used for quick letter-to-number conversion of ep identifiers.

0=lp, 1=kb, 2=lp+ip, 3=kb+ip, 4=mr+lp+ip,
5=mr+lp, 6=mr+kb+ip, 7=mr+kb, 8=lp+aud,
9=lp+ip+aud, A=mr+lp+ip+aud, B=mr+lp+aud,
C=kb+aud, D=kb+ip+aud, E=mr+kb+ip+aud, F=mr+kb+aud

kb = Keyboard
lp = Light Pen
ip = Image Projector
mr = Multiple Response
aud = Audio

Fig. 7. Coding for all possible combinations in position 10 of ep identifiers.

Final Examination

Once the author has decided on the type of tests needed in the course and on their frequency of occurrence, the programer will want to consider programing strategies to insure that students' responses are recorded accurately and that results are easily accessible for those authors who request them. In CARE 1, tests within chapters vary from author to author and from chapter to chapter. They generally follow the conventional question-response-feedback format and are placed throughout the instructional parts of the course. However, after each student completes the 22 instructional chapters, he takes a final, on-line examination. This examination, an evaluative instrument, measures the student's knowledge of the 14 concept-objective areas shown in Figure 6 (under the heading "Subset"). Each student is presented, via the CRT, with 75 questions randomly selected from a pool of 225. These questions are distributed according to a scheme shown in the last two columns of Figure 6. Questions are either completion or multiple choice, with no images or audio messages accompanying them. Though no questions can be skipped or left unanswered, a student is permitted, throughout the examination, to refer to his CARE 1 Handbook. Because of the random selection technique, it is extremely unlikely that any two students will receive the same combination of questions.

Scores (i.e., the number of correct answers) are registered in two ways: in student records and as proctor messages typed out by the 1518 typewriter. The latter permits immediate access to information that is useful in assigning students' grades. In order to keep such scores confidential, they are typed out in the semi-coded format shown on the following page. (Figure 8)

```
station   nn   nnn   CAREl
CAREl  COURSE OVER:  CLEAR BUFFERS -- lnnnnlnnnnlnnnnlnnnn
```

The two n's in the first line of the proctor message (n=number) indicate the station number, and the next three indicate the student number. The first 14 n's in the second line correspond to the literal score in each of the 14 subsets of the examination.* The final two n's correspond to the total score. (The l's can be ignored.) For example:

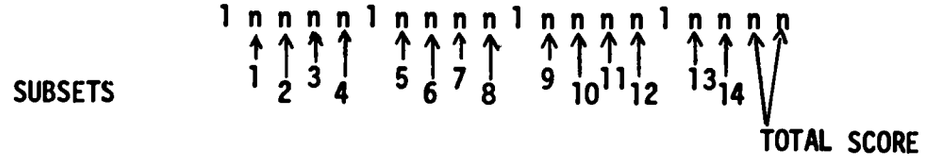


Fig. 8. Semi-coded proctor message typed on the 1518 typewriter (with explanatory key) which reports final examination scores.

*SUBSET	CONTENT	# OF ITEMS IN SUBSET	# OF ITEMS DRAWN RANDOMLY
1	Chapters 1,3,5	24	8
2	Chapter 2	12	4
3	Chapter 4,16	18	6
4	Chapter 6	15	5
5	Chapter 7	15	5
6	Chapter 8	15	5
7	Chapter 9	15	5
8	Chapter 10	15	5
9	Chapter 11	15	5
10	Chapter 12	15	5
11	Chapter 13	15	5
12	Chapters 14,15	21	7
13	Chapter 17	12	4
14	Chapter 18	18	6
		225	75

Fig. 9. Chart showing distribution of questions on final examination.

How To

Each student who takes a CAI course for the first time must be given instructions in communicating with the system. Since the number of students requiring this instruction is so large as to make individual instruction inefficient, the program "How To" was written.

"How To" broadly describes the nature of computer-assisted instruction and identifies (through the use of images) the equipment and the techniques used in responding to questions. In a few sample instructional frames, the student practices these techniques for which he receives appropriate instructional feedback. For instance, the student types answers to questions using the keyboard, and he also touches his light pen to one of several choices on the CRT. Feedback appears as text on the CRT or as an audio message, or both. The student is also instructed in the procedure for "erasing" erroneous keyboard responses before they are "entered" as answers.

Because a student is initially signed on to "How To" by a proctor, he must be taught to sign on by himself for subsequent lessons. This procedure is also taught in "How To"--by means of audio and CRT instruction--and is coordinated with instruction in signing off. After both procedures are demonstrated and the student successfully signs off, he then follows the instructions for signing on. If any difficulty is encountered while he is signed off, he can refer to a printed version of the sign-on instructions attached to the left of the image projector.

This "How To" introduction has proved to be an effective, instructional tool. It has rarely been necessary to supplement its contents with extra information--either from a proctor or from additional printed material.

Image Production

When allotting time for various phases of course preparation, one should be aware of the time invested in planning and producing images. This injunction applies not only to original preparation by a graphic artist (or photographer) but also to filming and final processing. Because deadlines will always exist and must be met, a systematic plan is imperative.

Courses developed at the Penn State CAI Laboratory, including CARE 1, have generally followed standard operational patterns. Images are first roughly sketched or described on an Image Planning Form (Figure 10). They are either photographs or lettered and/or drawn figures designed to illustrate or accentuate some principle or idea in the course. The author includes on the Planning Form any "special instructions" to the graphic artist, that is, whether images should be photographs, drawings, or simply lettered text. If color combinations are critical, he can include the specific details on the Form.

Before the completed forms are given to the graphic artist, however, the programer reviews them and assigns numbers to each. These numbers are logged on an Image Reel Program Sheet (Figure 11). They identify each image with its future "address" on the completed reel.

The drawn and lettered image requests are then separated from photographic requests. The graphic artist makes the necessary arrangements with a photographer for the latter and begins production work on the former. Besides the production means mentioned above, the graphic artist often uses acetate overlays when portions of a repeated base image are altered. These overlays, along with drawn or lettered images as well as slides (the final version of photographic requests) are then reviewed by the author. After the author's corrections and revisions are processed and the images rechecked, the finished images are arranged in proper sequence--the order in which they will appear on the final film. They are photographed at the University film lab, using 16mm, type 7252 Ektachrome commercial film, and then sent to a processor for developing. Within one week an original copy is received from the processor and is examined by the author and graphic artist for quality and sequencing. If

IMAGE PLANNING FORM Image No._____

Date:_____ Author:_____ Date Required:_____ Course:_____

SPECIAL INSTRUCTIONS_____

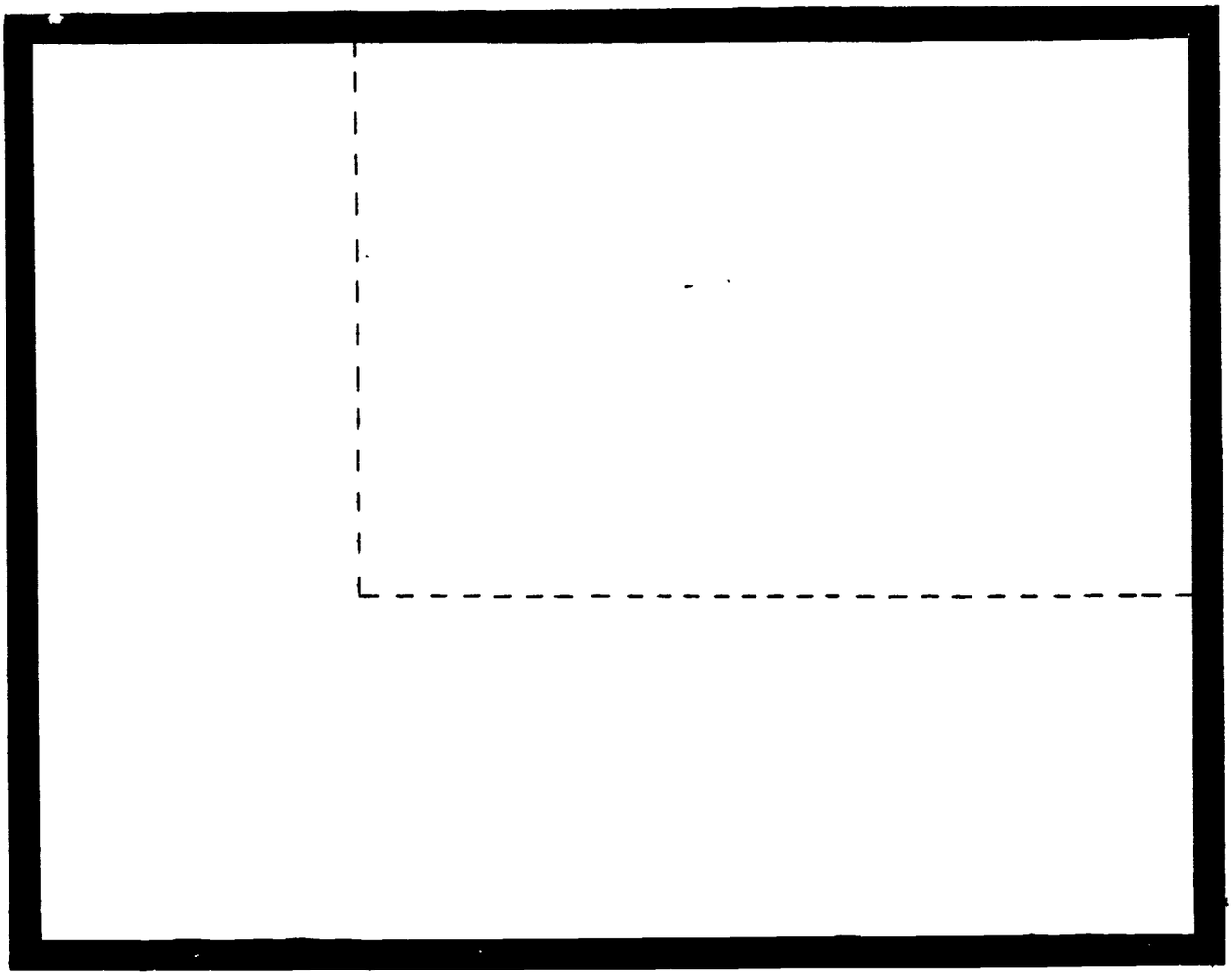
_____

If lettered:	If drawn:	Description:
[] Black letters on white ground	[] Line drawing	_____
[] White letters on black ground	[] Area drawing	_____
[] Colored letters_____	[] Other _____	_____
Colored ground _____	_____	_____

SKETCH

Please use the space enclosed by dotted lines for typewritten copy.
Use the large rectangle for drawing (remember to use letters no smaller than the minimum size in the large rectangle, and typewritten size in the small area).*

THIS SIDE UP! Horizontal Format Must Be used for Images. THIS SIDE UP!



*Minimum letter size for use in large rectangle = a

SUBMITTED:_____ COMPLETED:_____

NOTES: _____

11/70

Fig. 10. Image Planning Form.

COMPUTER ASSISTED INSTRUCTION LABORATORY

COURSE:
AUTHOR(S):
FILM NUMBERS:

201 Chambers Building

DATE_____

IMAGE REEL PROGRAM SHEET

PAGE 1

FILM ADDRESS	COPY NO.	FILM ADDRESS	COPY NO.	FILM ADDRESS	COPY NO.	FILM ADDRESS	COPY NO.	FILM ADDRESS	COPY NO.	FILM ADDRESS	COPY NO.
1		34		67		101		134		167	
2		35		68		102		135		168	
3		36		69		103		136		169	
4		37		70		104		137		170	
5		38		71		105		138		171	
6		39		72		106		139		172	
7		40		73		107		140		173	
8		41		74		108		141		174	
9		42		75		109		142		175	
10		43		76		110		143		176	
11		44		77		111		144		177	
12		45		78		112		145		178	
13		46		79		113		146		179	
14		47		80		114		147		180	
15		48		81		115		148		181	
16		49		82		116		149		182	
17		50		83		117		150		183	
18		51		84		118		151		184	
19		52		85		119		152		185	
20		53		86		120		153		186	
21		54		87		121		154		187	
22		55		88		122		155		188	
23		56		89		123		156		189	
24		57		90		124		157		190	
25		58		91		125		158		191	
26		59		92		126		159		192	
27		60		93		127		160		193	
28		61		94		128		161		194	
29		62		95		129		162		195	
30		63		96		130		163		196	
31		64		97		131		164		197	
32		65		98		132		165		198	
33		66		99		133		166		199	
				100						200	

Fig. 11. Image Reel Program Sheet (first page).

accepted,[12] the film is synchronized with an address track and sent back to the film processor for printing. When an "answer print" (the first copy of the final version) is received, it is mounted on a film reel and tried out on the 1512 image projector. If accepted, the necessary number of additional copies are ordered.

A word of caution. The actual programing of image statements (fp's) should be postponed, until the author is fairly certain that frame or segment sequences are determined. This is to avoid revisions of image program statements and the Image Reel Program Sheets. Both types of revisions are time consuming and are the cause of endless confusion. Also an efficient scheme for identifying images and for programing them will reduce this confusion when revisions are necessary. In one method the identifiers (or names) assigned to each image were frame numbers, that is, the actual "fp" statement numbers. Each fp statement in the course was preceded immediately by a label identical to that number. This provided for efficient on-line revisions because, by "typing" the label, the programer can immediately locate any image within a segment.

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[12] If better versions from past filmings are available, they can be spliced into the original copy at this time.

Label and Segment Scheme

A systematic and meaningful method for identifying parts of a course (i.e., chapters, segments, and frame labels) while it is being written and programed is essential. Without it, effective communication between the programer and the author during the developmental phase is reduced.

CARE 1 is divided into twenty-two chapters, each chapter being a relatively discrete portion of instructional information: e.g., "mental retardation," "cultural disadvantage," "emotional disturbance." Each chapter, in turn, is identified by one or more segment numbers (depending upon the amount of instructional information in a chapter) and also by a label made up of letters and numerals uniquely descriptive for each chapter. The segment numbers are Arabic numerals ranging from 0 through 127 (though, because of sequential gaps, segments total only 38). When possible, segments were kept to a size of 160 sectors[13] or below to facilitate disc building and rearranging during the developmental phase of the course. In those chapters where instructional information was sizable, there is, of course, more than one segment. Chapters 6, 8, 9, 11, 12, 14, 16, 17, and 19 each contain two or more segments.

The five-unit labels for CARE 1 segments (letters and numerals) generally appear in the format shown in Figure 12 below:

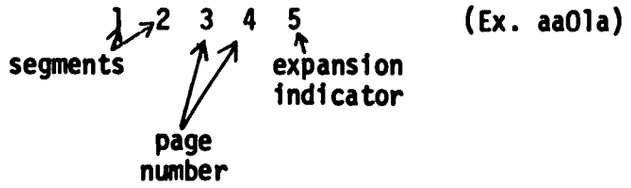

Fig. 12. Label format.

The first and second positions in a label are letters. The first letter indicates the alphabetical sequence of chapters; the second indicates an additional segment within a chapter. For example, label aa__ indicates the first

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[13] A sector is a unit of measure on a computer disc cartridge (which contains the actual course data).

segment in the first chapter, and label ab__ indicates the second segment in the same chapter. Label ba__ indicates the first segment in the second chapter, etc. The third and fourth units of a label are numerals ranging from 01 to 99. These indicate page or frame numbers within a segment. If necessary, these can be extended beyond 99 by incrementing the letter or number in the fifth position (and even further by adding and incrementing a letter in the sixth position). Mainly, however, the letter in the fifth position indicates an expansion of, or supplement to, a problem, frame, or page within a segment.

Perhaps an even better method would be to make labels within segments some form of that segment number. For example, segment 6 labels might be 6001a, 006aa, etc. This would facilitate the revision procedure for programers who could quickly identify the segment number for any given label.

Figure 13 on the following page shows the label and segment scheme. (The actual course scheme shown here is slightly different from the theoretical description given above. This was the result of a re-sequencing of segments during course development <u>after</u> labels had been assigned).

Chapter	Title	Segment	Labels
	How To; BIB (Biographical Inventory)	0	aa01/bib01a
1	Overview	3	aa01a
2	Information Processing Model	30	da01a
3	Interrelationship of Handicaps	33	dd01a
4	Gathering Information About Children	10	a001a
5	Decision Process	20	ca01a
6	Mental Retardation	40	c201a
		42	ec01a
7	Cultural Disadvantage	46	eg01a
8	Emotional Disturbance	52	en01a
		53	em01a
9	Visual Problems	60--64	fa01a
10	Hearing Problems	65	ga01a
11	Speech Problems	70	ha01a
		71	hb01a
12	Motor and Health Problems	80	ja01a/jb01a
		81	jc01a
13	Learning Disability	92	jn01a
14	Individual Differences and Normality	6	ab01a
		4--5	ae01a/af01a
15	Profiles of Individual Differences	7	ah01a
16	Reliability, Validity, and Usability	11	a1x1
		12	bc01a
17	Screening Instruments, Part One	41	eb01a
18	Screening Instruments, Part Two	23	cd01a
19	Screening Instruments, Part Three	24	ce01a
20	Documentation and Referral Procedures	96	jp01a
21	Case History	100	ka01a
		101	ka73a
		102	kb60a
22	Summary	105	ma01a
	Final Examination	120	m001a/a1--n17
		127	Sign-off

Fig. 13. Label, Title, and Chapter Segment Scheme.

Off-line Reading Assignments

If students are required to do off-line reading, they ought to be reminded of that periodically.

Throughout CARE 1, reading assignments in the Handbook and in the required text book (Teacher Diagnosis of Educational Difficulties, edited by R. M. Smith) were made at the end of each on-line chapter of instruction. They were accompanied by reminders that material relating to the next instructional session should be read before starting the next instructional session on-line.

Off Routine

In some courses it is desirable to store certain information about a student's location in a course when he signs off. Such information as the frame number of the last image or the address of the last audio message would be useful in positioning audio reels for the student's next on-line session.

This "off-routine," as it was called in CARE 1, follows the same procedure used for commenting or replaying audio messages (see ASA). When ready to sign off, the student, via a CRT display, is allowed to choose to 1) sign off immediately, using the conventional procedures, or to 2) press the space bar and continue with the course until an automatic sign off occurs at the next restart frame. If he chooses the first option, the student will be required to repeat several frames of instruction the next time he signs on (unless the frame at which he signed off was a restart frame). If he chooses the second option, the student resumes instruction at the frame immediately following the sign-off frame.

This particular "off-routine" was used with the first group of students for CARE 1, but it was subsequently abandoned for the following reasons:

1. Students were often confused by the accessing procedure;
2. The instruction time for frames between restart points could not always be gauged accurately, and thus the time between accessing and automatic sign off could not be predicted.

On-Routine

When designing a course, authors and programers will have to decide on the kinds of auxiliary information to give the student immediately after sign on. This will depend largely on the nature of the course. If the course contains audio, the correct reel will have to be designated, and information on the use of earphones may have to be displayed. Also, a student may need to know what off-line materials or workbooks to use.

Each time a student signs on to CARE 1, for instance, and before he resumes course instruction, he goes to a restart frame. Within that restart frame is a statement branching him to an "on-routine." The on-routine is essentially a CRT display telling the student which audio and image reels are needed for the instruction that is to follow. It also asks him to make sure the correct reels are loaded.

If at this time switch 1 is turned on (see Restart Points), he will see an additional message displayed: PLEASE PUT ON YOUR EARPHONES. Conversely, if switch 1 is turned off, the message will not appear.

When the student is ready to resume course instruction, he presses the space bar. At this time, switch 31 is turned off (so that the student will not repeat this operation at subsequent restart frames), and he advances to the first instructional frame in the course.

Projected Completion Time

The projected completion time routine was developed for CARE 1 to assist proctors and students in scheduling terminal time. This routine is included at the beginning of each segment and is used to project the amount of time the student has remaining until completion of the course.[14]

The formulae in Figure 14 below were used:

$$\text{Student projected completion time} = \frac{\text{student time to this point} \times \text{average completion time}}{\text{average time to this point}}$$

$$\text{Time remaining to completion} = \text{student projected time} - \text{student time to this point}$$

Fig. 14. Formulae for projected completion time.

The "averages" are based on data from the first site (Clearfield, Pa.). Student time to this point is the actual amount of time the student has been on line.

[14]Students who have been registered or who have taken one or more segments out of sequence are branched around the routine. This branching will occur in the segment in which they were initially transferred and in all subsequent segments.

Psaddl Macro

During the developmental phase of a course, it is suggested that students' responses be monitored in as many ways as possible for revision purposes. One way is to code "ep identifiers." (See Ep Identifiers) Unfortunately, this information is available only through student records, which can be costly to analyze and print. Also, the information must be "interpreted."

In CARE 1, an eight-statement macro was used. The information was obtained from listings, and it consisted merely of numbers which indicated the times a student answered questions incorrectly or answered with an unanticipated response.

The major disadvantages of psaddl were size and frequency of use. Because it was called at least twice in every answer processing frame, it expanded the course size considerably--approximately 22%. Increased size also resulted in slower execution time. In addition, the macros had to be deleted from the course after the developmental phase was completed.

Revision Procedures

Before a course is ready for field use, it should be tested out by a pilot group of students. CARE 1 was tested out by two such groups, once in the summer of 1970 and once in the fall of 1970. (An additional group of students took a portion of the course in early 1970.) To benefit as much as possible from this developmental procedure, a system for recording and revising errors was devised. For instance, each student in the first pilot group was accompanied by a proctor who recorded, on 5 x 8-inch cards, the student's comments and the obvious program "bugs." (Bugs included errors in CRT text, graphic displays, images, and audio messages.) The 5 x 8-inch cards were then arranged in the correct label sequence within segments after being divided according to "concept" revisions and "program" revisions. Program revisions went immediately to the programer. Concept revisions were reviewed first by the author then passed on to the programer, often with additional notes. The author also sent the programer certain revisions gleaned from a careful study of student records. When all such revisions were collected, the programer revised the course segment by segment. The same procedure was followed for the second CARE 1 pilot group, except that the student recorded comments without the aid of a proctor.

During October and November of 1970, 115 inservice teachers took the course for full credit. Student performance records were analyzed carefully, and a complete revision of the course was made as a result of the analysis.

Of course, revising is an on-going process in CARE 1. Revisions are made continually as demands for more data are received and as requests for finer course adjustments filter in from the field.

Restart Points

Certain frames in a course should be designated as restart frames. These are locations at which a student begins instruction again after once having signed off. They are most effective when made an intrinsic part of the course scheme by the author as he writes. If inserted after the course is written, it may be difficult to locate the logical breaks where they should appear.

Restart points, identified by prr statements, were inserted at approximately every 4th or 5th frame throughout CARE 1. This means that a student has to review up to five frames of material at each restart unless he happens to sign off at a frame containing a prr.

The coding at each restart point is shown in Figure 15 below:

Statement No.	Operand
1.	prr
2.	ld 0/s1 (or ld 1/s1)
3.	br on/s31/1
4.	fpl nnn (optional)
5.	au ann (optional)

Fig. 15. Restart point coding.

The condition of switch 1(s1) in statement number 2 determines whether or not the student is presented the message PLEASE PUT ON YOUR EARPHONES.

Since switch 31(s31) is always set to 1 at sign on, the student will automatically branch to the "on-routine" when he executes statement number 3. (See also On-routine)

Statements 4 and 5 are optional and are needed only when an image and/or an audio message are to be presented. An image will be reshown (statement number 4) if it is determined that an image would have been continued from a previous frame. An audio tape will be positioned (statement number 5) if it is determined that an audio message must be played either at the restart frame or during the next few frames.

Student Progress Summary

The Student Progress Summary (SPS) is a computer program that generates a report from information stored in the students' user file. SPS is run at the end of each day to provide an up-to-date list of the following information for each student:

1. student name
2. student number
3. course segment number
4. course restart label
5. total time on line
6. audio tape number
7. estimated time remaining to completion
8. true sequence indicator

Besides giving a daily summary of each student's progress, SPS aids the proctor in scheduling terminal time and in seeing that the correct audio tapes are loaded. See Figure 16.

COURSE--CARE1U SECTION--X DATE--03/09/71

NAME	USER	SEC.	LABEL	TIME	AUDIO	ETC
DAVID C. BECKER	X01	127	01 2	1484	8	0
CHERYL COUNTERMINE	X03	101	KB11A	1131	8	758
JUNE S. HANNA	X04	119	M0000A	2095	8	612
JOAN D. HARVEY	X05	105	PCT	1304	8	380
MARY R. MC CREIGHT	X06	41	EB35A	1118	7	818
BETTY ANN MORRISON	X07	127	01 2	1324	8	0
CATHLEEN R. RANNELS	X08	119	M0000A	1919	8	1087
ROSALINE ANN REEVES	X09	119	M0000A	1195	8	562
CHRISTINE I. ROGERS	X10	127	01 2	1196	8	0
PATRICIA ANNE SMITH	X11	127	01 2	1449	8	0
DIANE MARIE STEARNS	X12	100	INTRO	1171	8	629
FRANCINE B. STERN	X13	41	EB03A	1130	7	940
LINDA MARY VALLELY	X14	127	01 2	1094	8	0
SUSAN WILLIAMS	X15	119	EPCT	1762	8	209
GERALD R. AMELOTTE	X17	24	CE34A	1218	7	1140
VIRGINIA P. BARLETT	X19	96	JP48A	1332	8	732
LYNNE TOBIE COHEN	X20	105	PCT	1424	8	511
JOANNE ERWICH	X21	127	01 2	1196	8	0
DONNA MARIE GRGURAS	X22	41	EB42A	1312	7	1100
SUSANNE M. GRIFFITY	X23	23	CD10A	1285	6	1324
LINDA ANNE HURTADO	X24	102	KB83A	1733	8	636
DARRAGH W. KARR	X25	23	CD10A	1466	6	1586
CHRISTINE MOWERY	X27	24	CE03A	774	7	727
PAULETTE E. RUCKI	X28	127	01 2	1489	8	0
LEONARD TRESSLER	X29	127	01 2	1427	8	0
TERRIE TRUMBORE	X30	4	AE16A	700	2	1424
JANEANN M. RUNKLE	X32	119	M0000A	1496	8	714

Fig. 16. Student Progress Summary.

Visual Techniques

The way text or graphic material is presented on the CRT should be given some consideration when writing and programing instructional frames, although there is little beyond symmetrical appearance or aesthetic "balance" which can be used as guidelines. One broad rule of thumb is to avoid several consecutive screens filled with only text. The effect is a dulling of one's interest. For some, because of the lighted lettering, there is an irritation of the eyes. There may be a correlation between a student's attentiveness and the amount of "black space" on the screen.

In CARE 1, two techniques were used to reduce visual strain:

1. double spacing of the CRT text;
2. complete capitalization of the feedback text.

It was felt that the first would provide ease in reading and that the second would be an attention-getter. The second was also designed to "set off" feedback text from question text (the latter appearing in capital and lower case letters), thereby reducing confusion.

The course also included a half-second pause after feedback texts were erased in order to draw attention to the change and also to allow time for the disappearance of the "after image."